Express Mail Label No. IB571194704
I hereby certify that this paper is being deposited with the U.S. Postal Service as Express Mail addressed to the Commissioner of Patents and Trademarks, Washington, D.C. 20231 on 4-19-95.

By: Ellen M. Grzylak

08 424223

MAIL ROOM
10 APR 19 1995
PAT. & TRADEMARK OFF.

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant: Joseph Hummel

Serial No.: not yet assigned (continuation of S.N. 07/968,209)

Filed: October 29, 1992

Title: KNITTABLE YARN AND SAFETY APPAREL

Docket No.: 10-142C3

Watts, Hoffmann, Fisher &
Heinke Co., L.P.A.
100 Erieview Plaza
Suite 2850
Cleveland, Ohio 44114

Commissioner of Patents and Trademarks
Washington, D. C. 20231

RULE 132 DECLARATION

Dear Sir:

Now comes Joseph Hummel, the above-named applicant, who states as follows:

1. I have tested the cut-resistance of yarns constructed as shown in Figure 1 of the above-identified application, with the exception that the third covering wrap 16 was omitted. The purpose of the testing was to show the relative cut-resistance of composite yarn constructions having a core and covering wraps that utilize different fibers; specifically Kevlar, Spectra, Vectran HS, Vectran M, and polyester fiber. Kevlar is a high strength aramid fiber, Spectra is a high strength stretched or extended chain polyethylene fiber, Vectran HS is a high strength liquid crystal polymer fiber, Vectran M is a normal strength liquid crystal polymer fiber, and polyester is a normal strength fiber. Normal strength as used herein means a tenacity of no greater than 10 grams per denier.

2. Different yarn constructions identified by yarn numbers 1842-1852 and 1862-1864 were made and subjected to slash tests. The constructions and test results are set forth on Exhibit A hereto, which consists of three columns. The first column sets forth slash test results for yarns having no steel wire in the core and specifies the denier and fiber of a core strand and each of two wrapping strands, which are of the same fiber as the core, wound in opposite directions about the core. The average slash strength or cut-resistance for each construction is indicated in pounds. The second column sets forth the test results for yarns of similar construction to those described in column one, except for having an additional core strand of stainless steel wire .002 inch in diameter, and each having a first wrap of the same fiber as the core and a second wrap of polyester fiber. The third column sets forth the test results for yarns of similar construction to those described in column one, except for an additional core strand of stainless steel wire .002 inch in diameter. Exhibit B hereto sets forth the same construction as Exhibit A, but the average slash results shown on Exhibit A have been mathematically adjusted to compensate for the different deniers of different strands of Kevlar, Spectra, Vectran HS, Vectran M and polyester. Thus, the results in Exhibit B reflect expected cut-resistance if all core and wrapping strands were of 1000 denier.

- Parallel core strands?
- TPI of cover layers?

- how were they mathematically adjusted
- why not merely test invention against same using Kevlar of same using Vectran HS

3. The slash test procedure used was intended to measurably simulate a knife under load contacting and moving across a fabric knitted from the yarn. The slash test was performed to determine and record the load that it took to cut through the knitted fabric. A relatively higher "slash test load" is indicative of a relatively more cut-resistant fabric.

- same fabric knit?

4. The slash test procedure was as follows. Each of the identified yarns was knitted into a fabric sample that was then manipulated so it was substantially flat. The fabric sample was placed into a test fixture constructed to stretch

the fabric sample and load each yarn or thread in the fabric to about a five pound tensile load. This amount of stretching is believed to put the fabric sample under an extreme test condition, since the fabric sample should be cut more easily when in tension. The test fixture and fabric sample were then placed in an Instron model 1136 test machine, and the fabric sample was oriented at a 45° angle relative to the direction that a sharpened test blade was moved. The test blade was moved under load in a straight line against the fabric sample. The weight or load acting on the test blade against the fabric sample is variable.

5. The test blade was carbide steel and had four sharpened and independent circumferentially spaced arcuate cutting sections. Each section of the test blade performed only one slash test. The test blade was removed and re-sharpened after all four sections performed a slash test. A test blade section is deemed "sharp" when a slash test load in the range of nine pounds to sixteen pounds causes the blade to cut through a standardized fabric using the above described procedure. The standardized fabric used is available from Bettcher Industries, Inc. under the name Handguard II. The Handguard II fabric is machine knitted two yarns in, five and one half needles per inch of a specific yarn of about 0.023 inch diameter. Each yarn has a core consisting of a multifilament strand of 375 denier Spectra 1000 fiber. Each yarn has oppositely wound helical wraps about the core. These wraps consist of, in the order set forth, a first and second wrap of a multifilament strand of 70 denier nylon fiber; a third wrap of one end of 0.0016 stainless steel; a fourth wrap of a multifilament strand of 400 denier Kevlar fiber; a fifth wrap of multifilament strand of 650 denier Spectra 900 fiber; and a sixth wrap of a multifilament strand of 440 denier polyester fiber.

6. The slash tests were performed so that the loaded test blade engaged the fabric sample three times. Each time, a new cutting section of the test blade was used and the blade engaged a different portion of the fabric at a different orientation relative to a knit loop. The three test orientations are directly across a knit loop, directly along a knit loop, and diagonally across a knit loop. The loads sufficient for the test blade to cut through each fabric sample in the three test directions were recorded and averaged. Each average slash value is an average of 25 readings. The average load required to cut completely through the fabric sample may be referred to as the "slash test load."

7. Physical characteristics of the fiber materials used in the yarn constructions tested are approximately as follows:

Material	Tenacity g/d	Tensile Modulus g/d	Elongation %
Kevlar	23	425,000	1.5 to 3
Spectra	30	375,000	3.5
Vectran HS	23	525,000	2 to 3
Vectran M	9	425,000	2 to 3
Polyester	9	160,000	13 to 15

8. Kevlar, Spectra and Vectran HS and M are typically referred to as high performance fibers. Kevlar, Spectra and Vectran HS were known by me to be highly cut-resistant as compared to low tenacity fibers. It was my belief, and to my knowledge, the general belief now by others, that the cut-resistant property of Kevlar, Spectra and Vectran HS was due essentially to the high tenacity.

9. I was not able to predict from the published physical characteristics of Vectran M that it would be cut-resistant. Rather, its low tenacity typical of polyester and nylon, led me to believe Vectran M would not be highly cut-resistant, because the fibers of such synthetic materials as Kevlar, Spectra and Vectran HS known to me to import high cut-

resistance to composite yarns had high tenacity. It was therefore surprising that, as shown by the comparisons of slash tests set forth in Exhibit A, and mathematically adjusted in Exhibit B, that Vectran M provided higher cut-resistance than Spectra when used in the yarn constructions tested; whereas, as expected, polyester fiber of similar tenacity to Vectran M produced significantly lower cut-resistance than Spectra. This now suggests to me that the common characteristic of cut-resistant fibers of synthetic materials is not tenacity, but appears to be high tensile modulus. This was not predictable from experimentally determined cut-resistance of Kevlar, Spectra and Vectran HS, because all three have both high tenacity and high tensile modulus.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of this application or any patent issued thereon.

Dated: April 13, 1995

Joseph Hummel

Joseph Hummel

08 424223

CUT EVAL COMPARISON VEC M VS HS

JH 1/20/95

YARN #	YARN CONSTRUCTION	AVG SLASH (LB)	YARN #	YARN CONSTRUCTION	AVG SLASH (LB)	YARN #	YARN CONSTRUCTION	AVG SLASH (LB)
1848	650 D POLYESTER- CORE 1ST - 650 D POLYESTER 2ND - 650 D POLYESTER	4.41	1842	650 D POLYESTER .002SS- CORE 1ST- 650 D POLYESTER 2ND- 650 D POLYESTER	5.17	1842	650 D POLYESTER .002SS- CORE 1ST- 650 D POLYESTER 2ND- 650 D POLYESTER	5.17
1849	650 D SPECTRA- CORE 1ST 650 D SPECTRA 2ND 650 D SPECTRA	5.06	1845	650 D SPECTRA .002- CORE 1ST- 650 D SPECTRA 2ND- 650 D POLYESTER	6.34	1844	650 D SPECTRA .002SS- CORE 1ST- 650 D SPECTRA 2ND- 650 D SPECTRA	7.28
1852	1000 D KEVLAR- CORE 1ST 1000 D KEVLAR 2ND 1000 D KEVLAR	14.42	1843	1000 D KEVLAR .002- CORE 1ST- 1000 D KEVLAR 2ND- 1000 D POLYESTER	10.73	1851	1000 D KEVLAR .002- CORE 1ST- 1000 D KEVLAR 2ND- 1000 D KEVLAR	14.12
1850	750 D VECTRAN M- CORE 1ST 750 D VECTRAN M 2ND 750 D VECTRAN M	7.92	1847 invention	750 D VECTRAN M .002 SS- CORE 1ST 750 D VECTRAN M 2ND 650 D POLYESTER	7.54	1846	750 D VECTRAN M .002- CORE 1ST- 750 D VECTRAN M 2ND - 750 D VECTRAN M	8.9
1864	750 D VECTRAN HS- CORE 1ST- 750 D VECTRAN HS 2ND- 750 D VECTRAN HS	8.19	1863	750 D VECTRAN HS .002- CORE 1ST- 750 D VECTRAN HS 2ND- 650 D POLYESTER	9.72	1862	750 D VECTRAN HS .002- CORE 1ST- 750 D VECTRAN HS 2ND-750 D VECTRAN HS	10.45

EXHIBIT A

CUT EVAL COMPARISON VEC M VS HS

JH 1/20/95

YARN #	YARN CONSTRUCTION	AVG SLASH (LB)	YARN #	YARN CONSTRUCTION	AVG SLASH (LB)	YARN #	YARN CONSTRUCTION	AVG SLASH (LB)
1848	650 D POLYESTER- CORE 1ST - 650 D POLYESTER 2ND - 650 D POLYESTER	5.95*	1842	650 D POLYESTER .002SS- CORE 1ST- 650 D POLYESTER 2ND- 650 D POLYESTER	6.98*	1842	650 D POLYESTER .002SS- CORE 1ST- 650 D POLYESTER 2ND- 650 D POLYESTER	6.98*
1849	650 D SPECTRA- CORE 1ST 650 D SPECTRA 2ND 650 D SPECTRA	6.83*	1845	650 D SPECTRA .002- CORE 1ST- 650 D SPECTRA 2ND- 650 D POLYESTER	8.57*	1844	650 D SPECTRA .002SS- CORE 1ST- 650 D SPECTRA 2ND- 650 D SPECTRA	9.83*
1852	1000 D KEVLAR- CORE 1ST 1000 D KEVLAR 2ND 1000 D KEVLAR	14.42	1843	1000 D KEVLAR .002- CORE 1ST- 1000 D KEVLAR 2ND- 1000 D POLYESTER	10.73	1851	1000 D KEVLAR .002- CORE 1ST- 1000 D KEVLAR 2ND- 1000 D KEVLAR	14.12
1850	750 D VECTRAN M- CORE 1ST 750 D VECTRAN M 2ND 750 D VECTRAN M	9.90*	1847 Invention	750 D VECTRAN M .002 SS- CORE 1ST 750 D VECTRAN M 2ND 650 D POLYESTER	9.43*	1846	750 D VECTRAN M .002- CORE 1ST- 750 D VECTRAN M 2ND - 750 D VECTRAN M	11.13*
1864	750 D VECTRAN HS- CORE 1ST- 750 D VECTRAN HS 2ND- 750 D VECTRAN HS	10.24*	1863	750 D VECTRAN HS ? .002 SS CORE 1ST- 750 D VECTRAN HS 2ND- 650 D POLYESTER	12.15*	1862	750 D VECTRAN HS .002- CORE 1ST- 750 D VECTRAN HS 2ND-750 D VECTRAN HS	13.06*

*ADJUSTED UP TO 1000 DENIER

EXHIBIT B

00 424223